PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in Cathodes and Method of making them

We, EGYESULT IZZOLAMPA ES VILLAMOSSAGI RESZVENY-TARSASAG, a Body Corporate, of 77, Vaci-ut. Budapest 4, Hungary, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to cathodes activated by caesium or rubidium. Known cathodes of this kind have a short life owing to the fact that the active substance, i.e., the caesium or rubidium is highly volatile which causes a rapid decrease in the emission from the cathode. Though caesium-cathodes have a low work-function the volatility of the active substance prohibits practical employment of such cathodes.

The object of this invention is a cathode activated by caesium or rubidium in a way which makes it possible to overcome the drawback caused by the volatility of the active substance.

According to the invention, the active substance in a cathode activated by caesium or rubidium is provided inside a closed box, part of the wall of which consists of porous tungsten.

Preferably the box is made from metal, for example, nickel or chromium.

In one embodiment of the cathode in accordance with the invention, the box contains metallic caesium or rubidium.

In another embodiment there are provided inside the box a compound of the active substance, and a reducing agent which can react with the compound so as to set free the active metal which, owing to its volatility, diffuses through the pores of the porous tungsten on to the surface of the tungsten.

The box may contain a compound of caesium, or of rubidium or of both substances, and a reducing agent.

In order to manufacture a cathode according to the invention by using metallic caesium or rubidium these substances are preferably enclosed in an air tight envelope during the manufacture of the cathode. By heating the compounds of caesium or rubidium with a reducing agent the metallic caesium or rubidium will be set free within the closed box.

In the preferred embodiment of the invention we use a box made of nickel which may be cylindrical in shape and which is closed at one end and open at the other. The metallic active substance, or its compound and the reducing agent, are then introduced into the box and the open end of the box is tightly closed by a piece of sintered porous tungsten. Thus the active metal can only diffuse through the pores of the tungsten, thereby activating the outer surface of the tungsten and lowering the work-function substantially. The vaporised caesium or rubidium, on diffusing through the tungsten is deposited on a large surface, thus constantly replacing the caesium volatilising out of the porous tungsten. As this process proceeds but slowly the cathode is assured of a long life.

The cathodes according to the invention may be used in all electric discharge tubes where cathodes of a low-work-function are required, such as fluorescent lamps, electro-flash lamps, lamps for stroboscopes and the like. In fluorescent lamps and in gaseous discharge lamps the cathode according to the invention has the special advantage of substantially facilitating the ignition of the lamp, so that in some cases special devices for this purpose can be dispensed with. The cathodes are especially adapted to be used as cold cathodes. They can be used to advantage in directly igniting fluorescent lamps with cold cathodes or as cathodes heated by the discharge itself, supplied with a current of 220 volts, over a choke, without any special starting device. The new cathodes can also be used in thyratrons with cold

cathodes. They can be fabricated as so called "gun"-cathodes as well as cathodes of a cylindrical shape.

The box serving to hold the active substance or its compound is preferably blackened or provided with cooling ribs, or both on its outer surface.

One method, for example, by which a caesium cathode according to the invention can be produced, comprises providing the metallic caesium inside a tightly closed envelope such as a small capsule or bulb made of glass, in order to avoid volatilisation of the substance. This capsule or bulb is then introduced into a small box made of nickel, chromium or any other metal adapted to be used *in vacuo* which is open on one side only. The box is then tightly closed by a body made of sintered porous tungsten.

If, instead of metallic caesium, a caesium compound is used together with a reducing agent, these substances may be provided inside the metal-box without any separate envelope. The compound of caesium which we prefer to use is the chromate or tungstate and as a reducing agent, metallic tungsten. If caesium tungstate is used, the reduction process is a slow one, resulting in the formation of metallic caesium, tungsten oxide and tungsten bronzes. It is this slow reduction process which gives the finished cathode its long life. Both substances are inserted into the box separately or in the form of a compressed pill. Compounds of a caesium with a halogen of low atomic weight such as caesium fluoride or caesium chloride and as a reducing agent a metal, for example, iron, but preferably an alkaline metal such as sodium or a group III metal such as aluminium, have been proved to be well suited. The metallic box is then closed tightly by a body made of sintered, porous tungsten.

After closing the box the cathode is mounted in the tube and the tube closed in the usual manner. Then the caesium is set free by heating the cathode, e.g., by producing discharges in the tube. In cases where the active metal has been introduced into the box in a container made of glass this container cracks under the influence of heat and the metal is set free. The caesium thus diffuses through the porous body of tungsten as explained above. Where the box has been filled with a compound of caesium and a reducing agent, the reaction takes place during those times when the cathode is heated and the caesium set free will constantly diffuse on to the surface of the sintered porous tungsten. In our experience, caesium chloride has proved itself particularly useful, the caesium being set free during a slow reaction so that the active substance is constantly replenished.

The cathode may also be heated by supplying heat to the cathode from outside the tube.

What we claim is:—

1. A cathode for electric discharge tubes, containing an active substance of caesium and/or rubidium, in which the active substance is provided inside a closed box, part of the wall of which consists of porous tungsten.

2. A cathode according to Claim 1 in which the box is made from metal, preferably nickel or chromium.

3. A cathode according to Claim 1 or Claim 2 in which the box contains metallic caesium or rubidium.

4. A cathode according to Claim 1 or Claim 2 in which the box contains a compound of caesium or of rubidium or of both substances and a reducing agent.

5. A cathode according to any preceding claim in which the outer surface of the box is provided with cooling fins.

6. A cathode according to any preceding claim in which the outer surface of the box and/or the cooling fins is blackened.

7. A cathode according to any preceding claim which is cylindrical in shape.

8. A cathode according to any one of Claims 1-6 which is shaped so as to be suitable for use in an electron gun.

9. A cathode according to any one of Claims 4-8 in which the box contains caesium and/or rubidium chromate with aluminium and/or tungsten as a reducing agent.

10. A cathode according to any one of Claims 4-8 in which the box contains caesium and/or rubidium tungstate and tungsten as a reducing agent.

11. A cathode according to Claim 4 in which the box contains a halide of caesium and/or rubidium of low atomic weight, such as a fluoride or a chloride and as a reducing agent a metal, for example, iron, but preferably an alkaline metal, such as sodium or a metal of group III of the Periodic system, such as aluminium.

12. A method of producing a cathode according to Claim 1 or Claim 2 or to any one of claims 4 to 11 comprising setting free the active substance, such as caesium or rubidium out of a compound of the metals within a closed space in the cathode, after having sealed the envelope of the discharge tube containing the cathode.

13. A method of producing a cathode according to any one of Claims 1 to 3 or Claims 5-11 comprising enclosing the metallic active substance in a tightly sealed envelope made of glass, introducing the charged envelope into a metallic box, closing the box by means of a porous body made of tungsten and cracking the envelope by heating the cathode.

14. A fluorescent lamp containing a

cathode according to any one of Claims 1 to 11.

15. A directly igniting fluorescent lamp containing a cold cathode or a cathode heated by the discharge according to any one of Claims 1 to 11.

16. A fluorescent lamp supplied through a choke with a current of about 220 volts, without any special igniting device and containing an emission-heated cathode according to any one of Claims 1 to 11.

17. An electro-flash lamp containing a cathode according to any one of Claims 1 to 11.

18. A stroboscope lamp containing a cathode according to any one of Claims 1 to 11.

19. A thyratron having a cathode according to any one of Claims 1 to 11.

20. A cathode for an electric discharge tube substantially as described herein.

21. A method of manufacturing a cathode for an electric discharge tube substantially as described herein.

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